

RESEARCH PROBLEM STATEMENT #RW-506

I – Problem Title

Develop criteria for using network GPS for airborne GPS photogrammetry.

II – Research Problem Statement

During recent years, Caltrans has successfully deployed the routine use of airborne GPS photogrammetry that requires the collection of GPS data at one or more ground stations to support flight missions. The use of a variety of existing continuously operating GPS network stations to eliminate the need for data from base stations has not been investigated.

III – Objective

Investigate what accuracy requirements can be met for airborne GPS photogrammetry by using the data from existing network of continuously operating GPS stations. Develop criteria and specifications for the use of existing network stations in support of flight missions. This study supports the Department's goal of performance by increasing the efficiency of data acquisition for planning and design.

IV – Background

Current Caltrans practice requires the collection of GPS data at a ground base station during photo flight missions. In addition to the deployment of equipment and personnel resources, this practice poses problems in planning field logistics especially when widely spaced flight missions are to be flown on the same day. A variety of existing GPS networks cover large portion of the State, and their data is being used for traditional ground GPS surveying. It needs to be investigated if such network data can effectively meet Caltrans' accuracy specifications for airborne GPS photogrammetry, and if so, to develop the criteria for the use of data from existing GPS networks.

V – Statement of Urgency and Benefits

The elimination for the need of ground base stations will free the equipment and field personnel for other productive tasks. It will also eliminate the need for critical coordination between the photography vendors and Caltrans' field personnel required for every flight mission. This will reduce flight scheduling delays, which may be critical for flight missions undertaken in support of emergency response.

VI – Related Research

While the use of data from network stations is rapidly increasing for ground based GPS surveys, the use of network data for establishing the aircraft trajectory to better than 10-cm level has not been investigated. Some of the relevant publications are:

* El-Mowafy A. (2000): Performance Analysis of the RTK Technique in an Urban Environment, Vol.45 The Australian Surveyor.

* Lachapelle G., Alves P., Fortes L. P., Cannon M. E. and Townsend B. (2000): DPGS RTK Positioning Using a Reference Network: Proceedings of ION-GPS 2000, The 13th

International Technical Meeting of the Satellite Division of the Institute of Navigation, Salt Lake City, Utah, pp. 1165-1171.

- * Lachapelle, G., E.M. Cannon, W Qiu, and C. Varner (1995): An Analysis of Differential and Absolute GPS Aircraft Positioning, ION NTM, Anaheim, CA.

- * Snay, R.A., (2000): The National and Cooperative CORS Systems in 2000 and Beyond, Proceedings of ION GPS 2000, Salt Lake City, UT, pp. 55-58.

- * Vollath U, Buecherl A, Landau H, Pagels C, Wagner B (2000): Multi-base RTK positioning using Virtual Reference Stations, 13th Tech. Meeting of the Satellite Div. of the U.S. Institute of Navigation, Salt Lake City, Utah, pp. 123-131.

- * Wu, J. T. (1994): Weighted differential GPS method for reducing ephemeris error, Manuscripta Geodaetica, 20, pp 1-7.

VII – Deployment Potential

If the research results indicate that the use of network GPS stations can meet Caltrans' accuracy standards, Caltrans will have a very strong incentive to routinely deploy the use of existing GPS network data. The need for the collection of data at ground based stations and field coordination with the photography vendor will be completely eliminated.